Yield, Nitrogen and Phosphorus Removal By Silage Barley in Commercial Fertilized and Manured Watersheds at the LFCE

2018 and 2019 Agronomic Results

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Context

- Adding manure to soil at the right time, rate and placement adds nutrients and organic matter that stimulates crop growth, microbial activity and increases carbon stored in the soil.

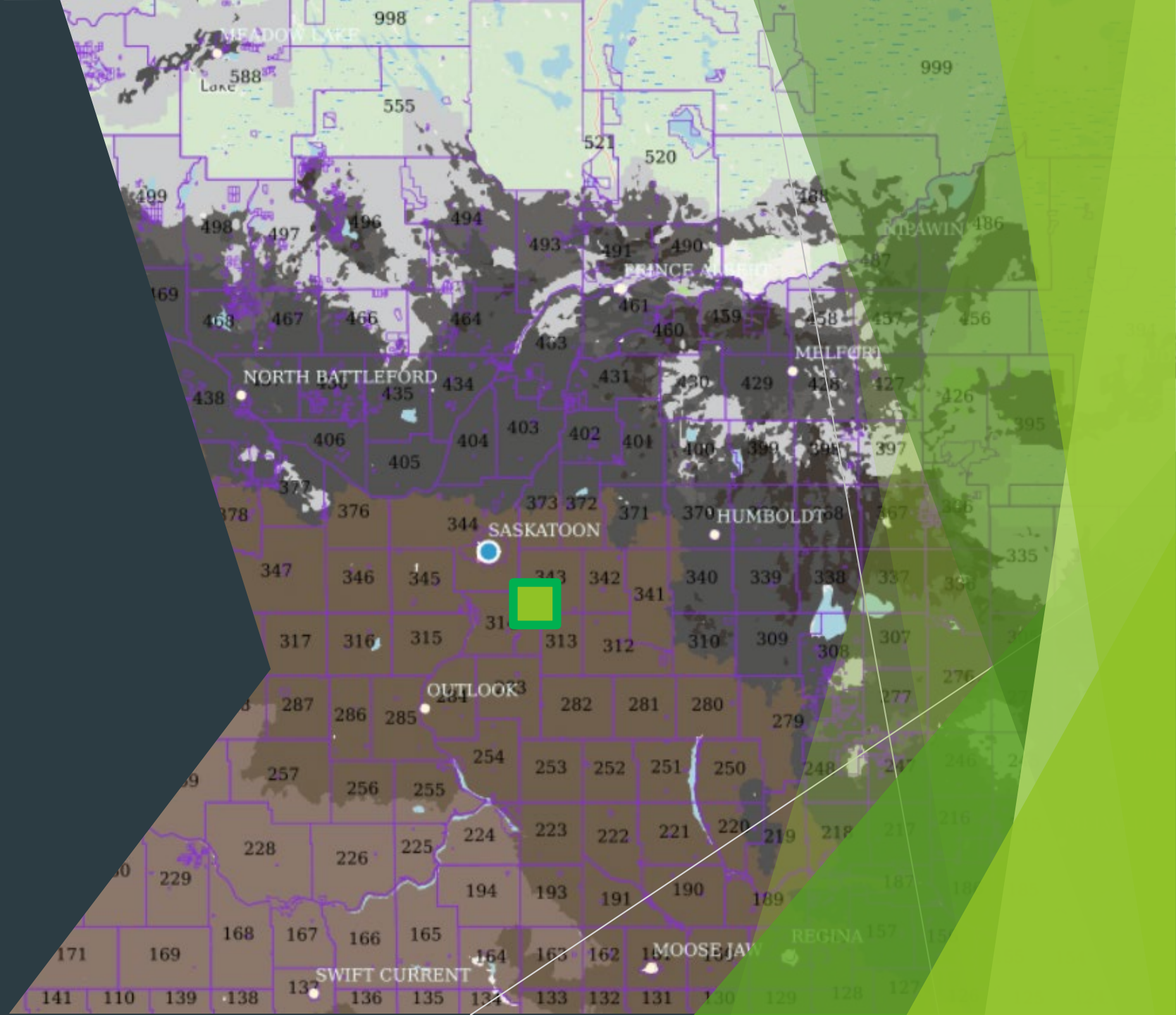
- Adding manure recycles nutrients through soil-plant systems.

Objective

To evaluate **agronomic** and environmental performance of cattle manure applications made at constant (traditional) and variable (precision) rates.

Site Description

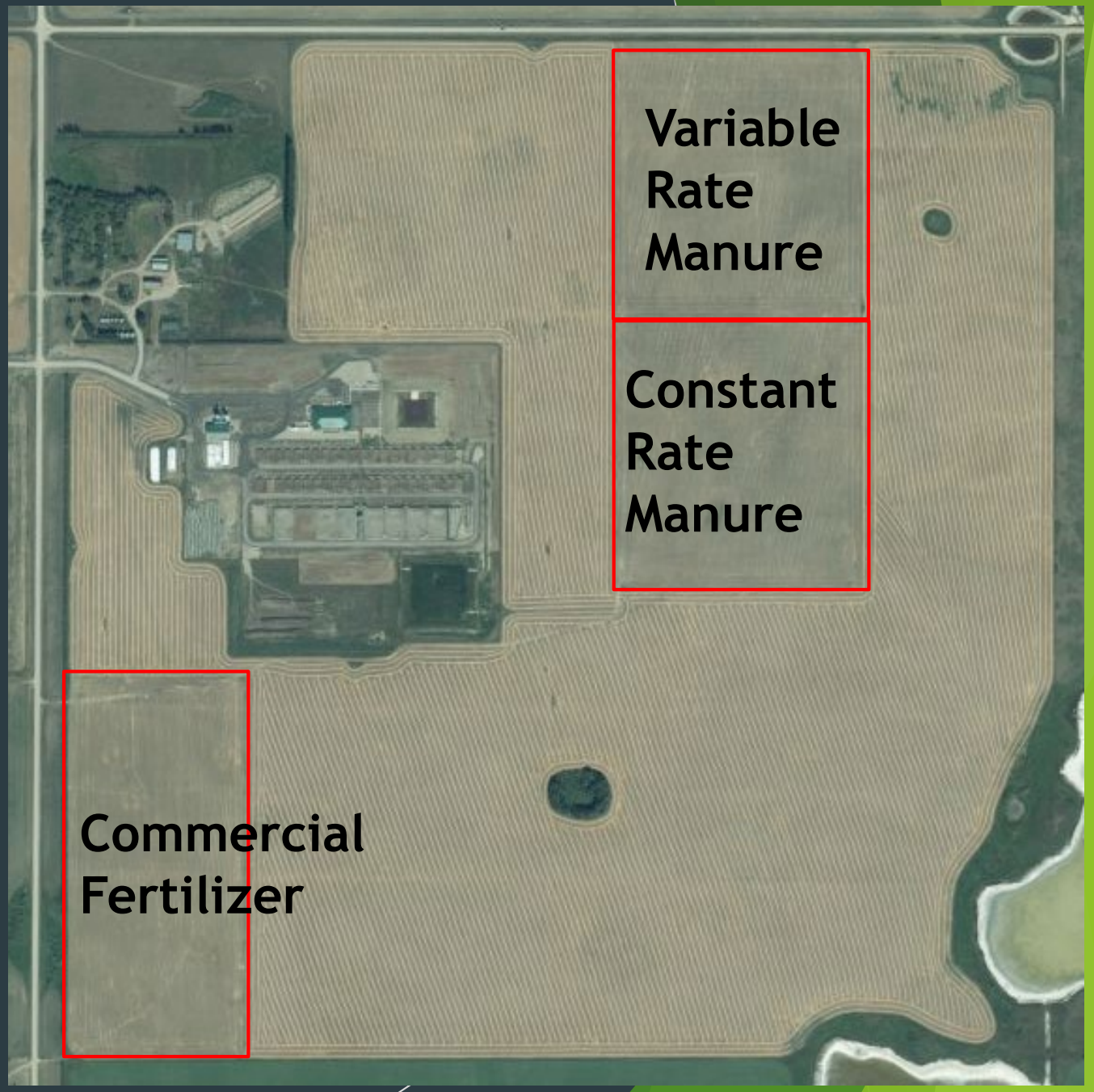
- Section 21 of RM 343 (Blucher)
- LFCE Feedlot
- Dark Brown Chernozem of Bradwell association.



- Map generated from Saskatchewan Soil Information System https://sksis.usask.ca/#/map

Study Treatments

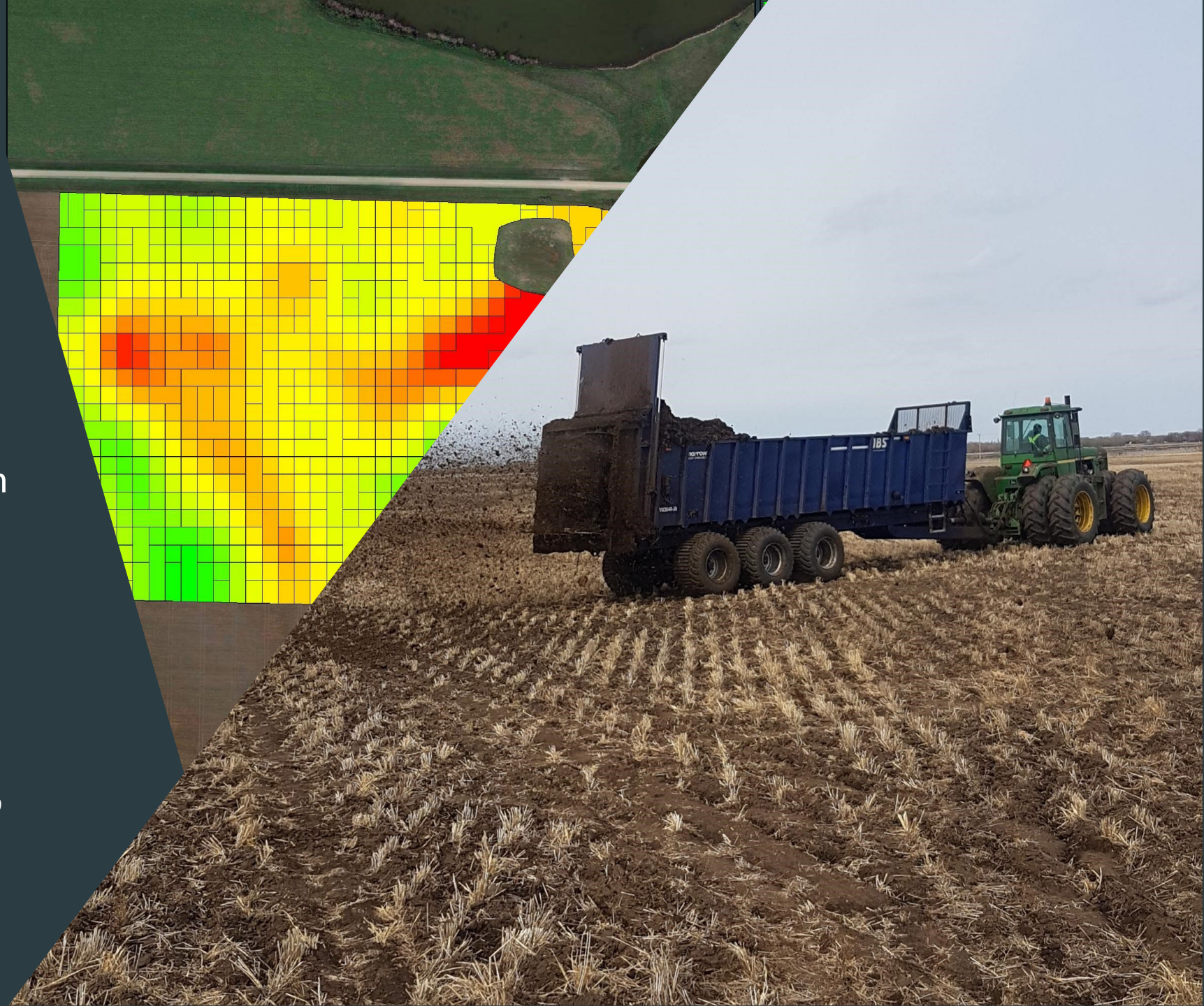
- 4 year study with manure application every 2nd year :2019, 2021.
- 3 ~40 acre treatment blocks: C, T, V
- Estimated removal of ~400 kg N/ha and 140 kg P_2O_5 ha^{-1} by silage barley crop over 2 years
- Non-composted content of ~0.6% N and ~0.3% P_2O_5
- Manure application based on P removal over 2 years -> 45 tonnes manure ha^{-1}
- 1st manure application May 1st and 2nd of 2019.



Equipment and Application

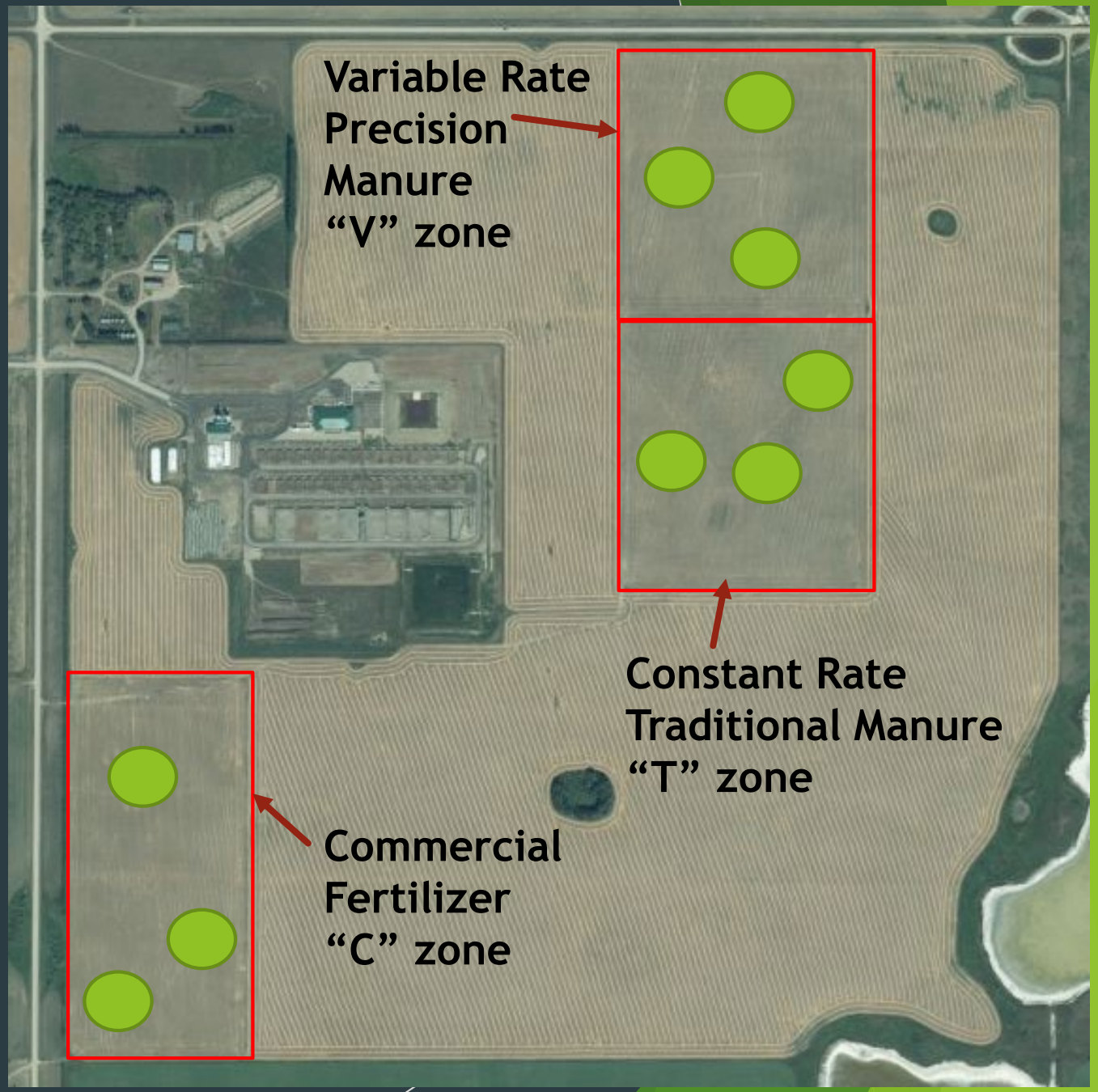
- 30 ft JBS Manure variable rate spreader with spreading width of 30 ft
- Variable rate application determined by Nutrien Echelon 16 yr NDVI imagery
- Variable Rate Precision Prescription (V zone):

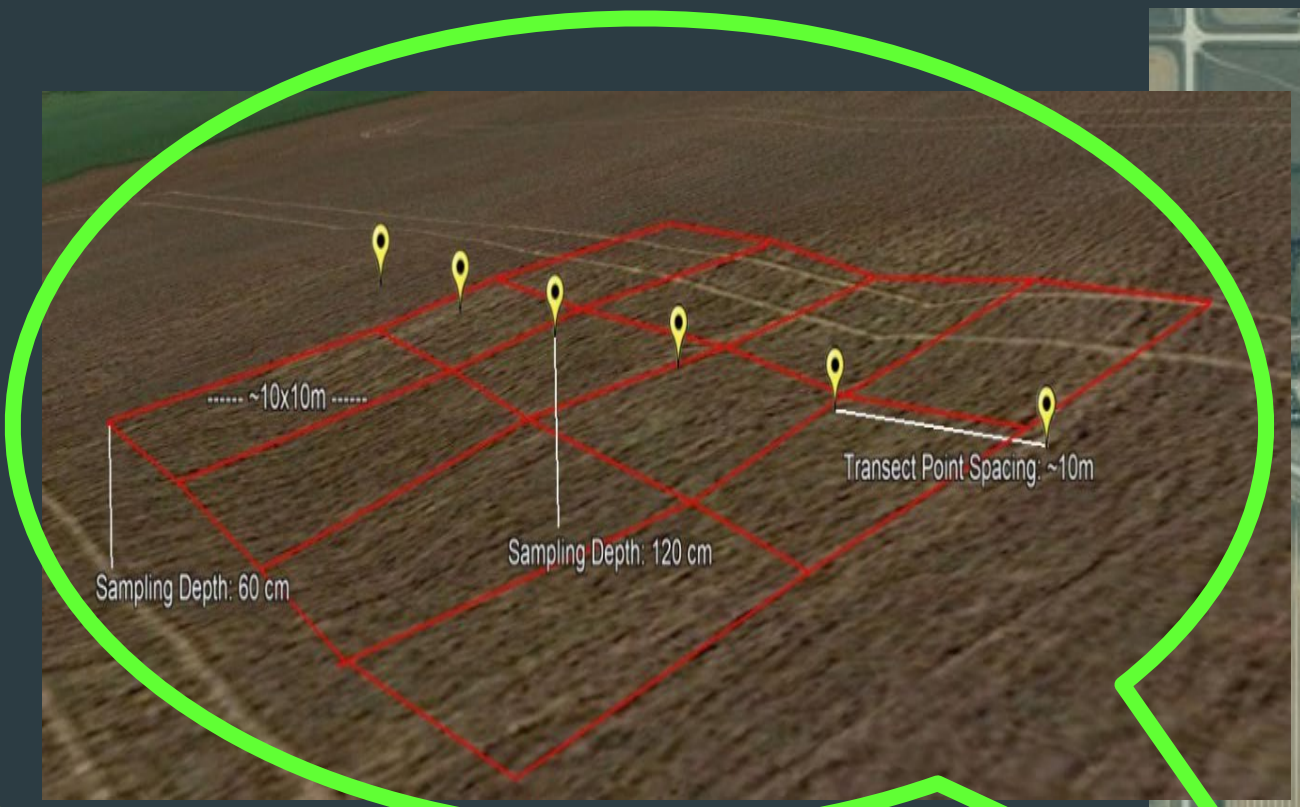
Less productive, higher slope positions received greater amounts of manure, footslopes received less, depressions received least. Set back with no manure in basin centers

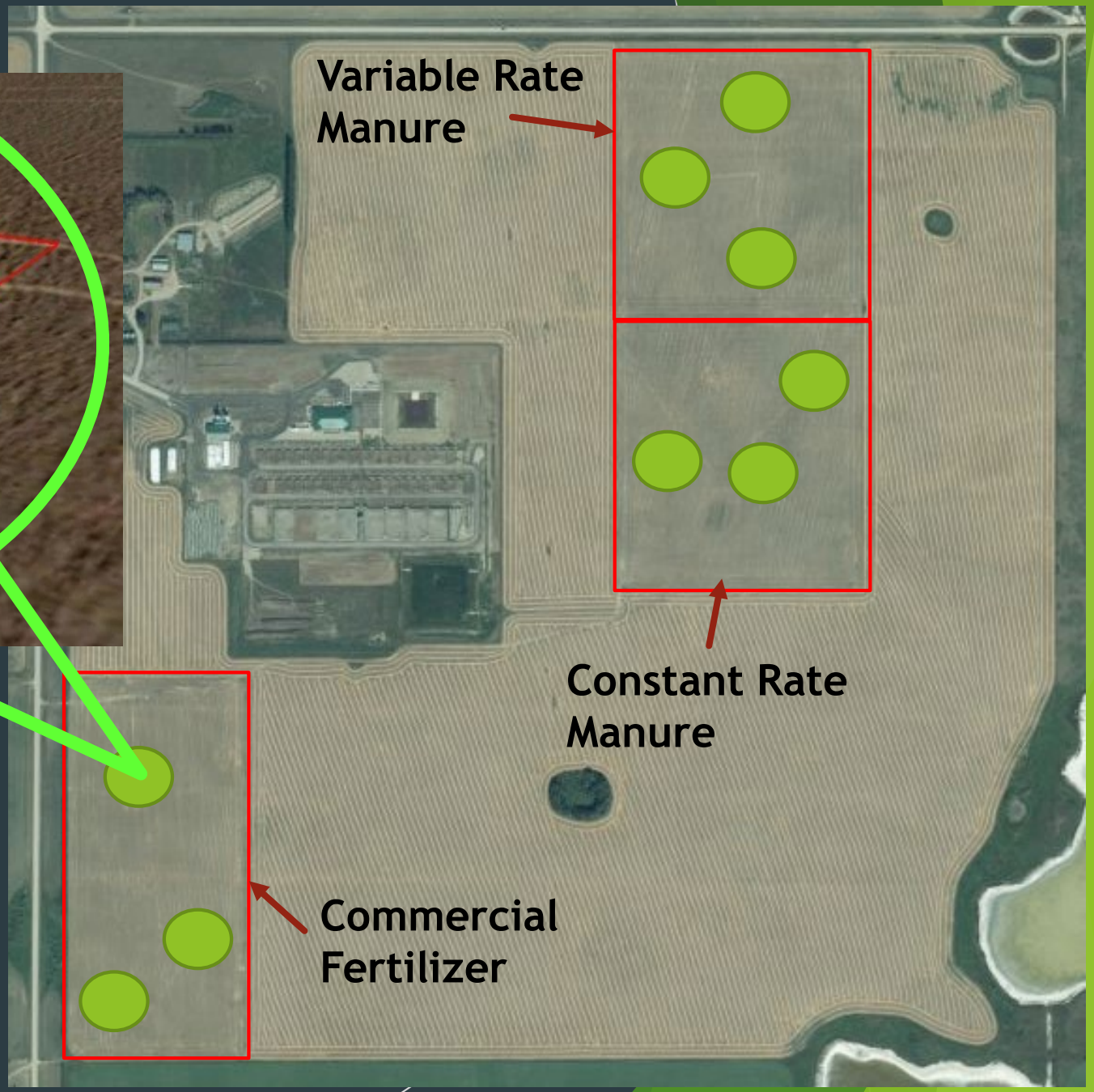


Design

- 3 Watersheds in each treatment zone block
- Manure spreader used set-back from watershed basin centers in variable rate application zone.
- All zones (C,T,V) received 80 kg N ha^{-1} as anhydrous ammonia in April 2019 to account for low N availability of fresh manure N in year of application.
- Commercial fertilizer (C zone) received 50 kg P_2O_5 ha^{-1} as MAP at time of seeding. Other zones received no P fertilizer.

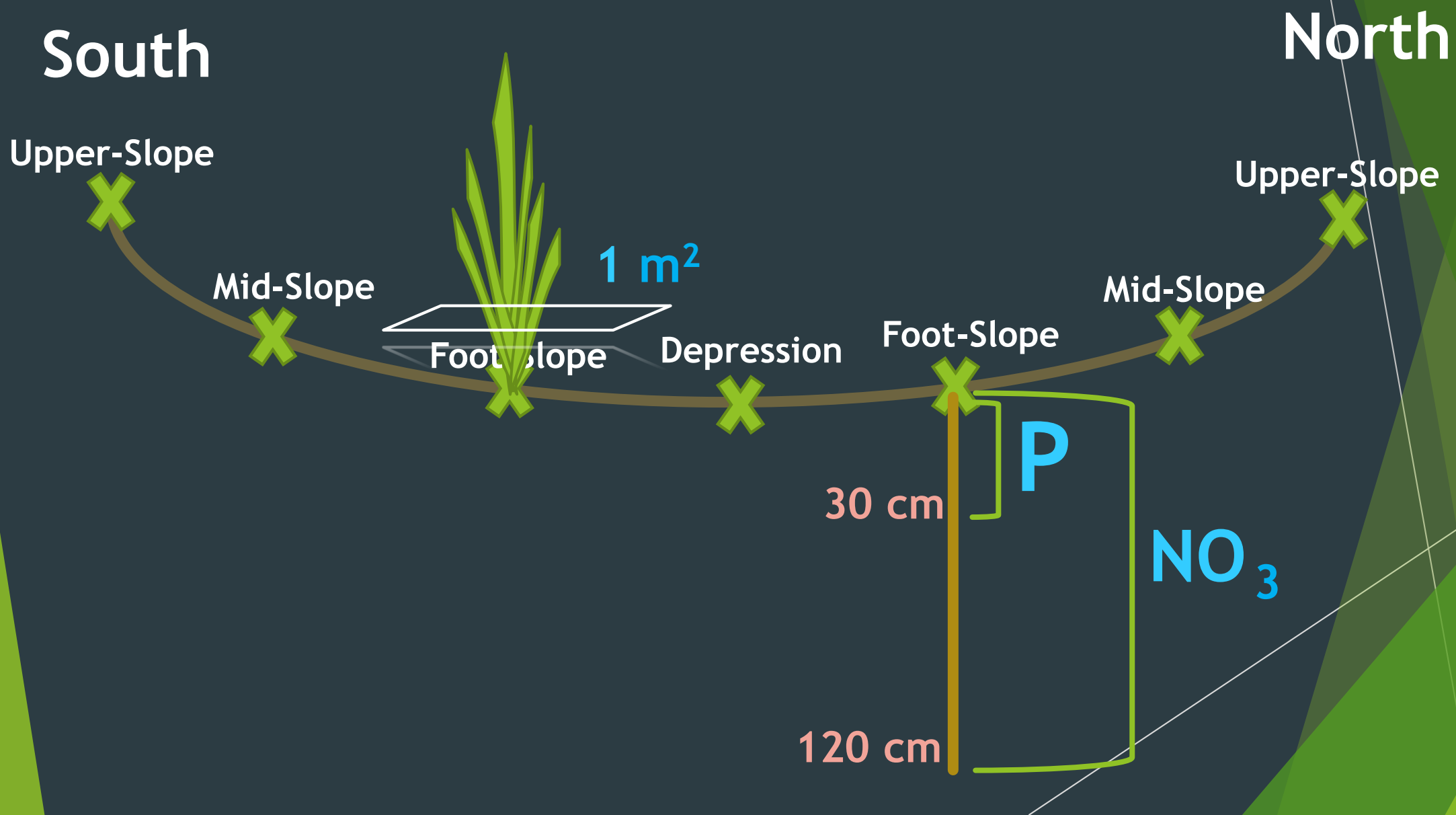



~10x10m
Transect Point Spacing: ~10m
Sampling Depth: 120 cm
Sampling Depth: 60 cm


Variable Rate Manure
Constant Rate Manure
Commercial Fertilizer

Watershed Sampling Diagram

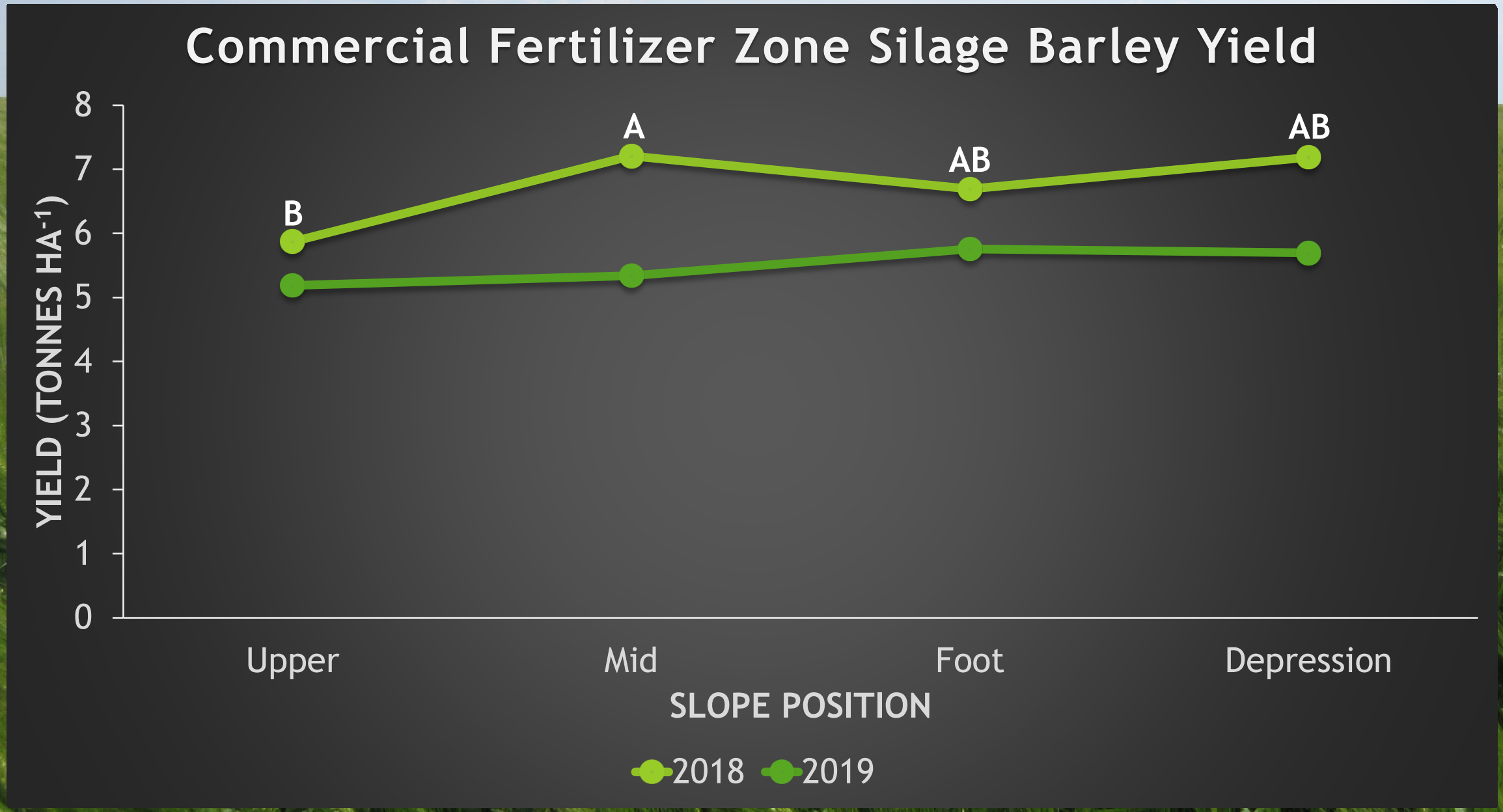
Watershed Sampling Diagram



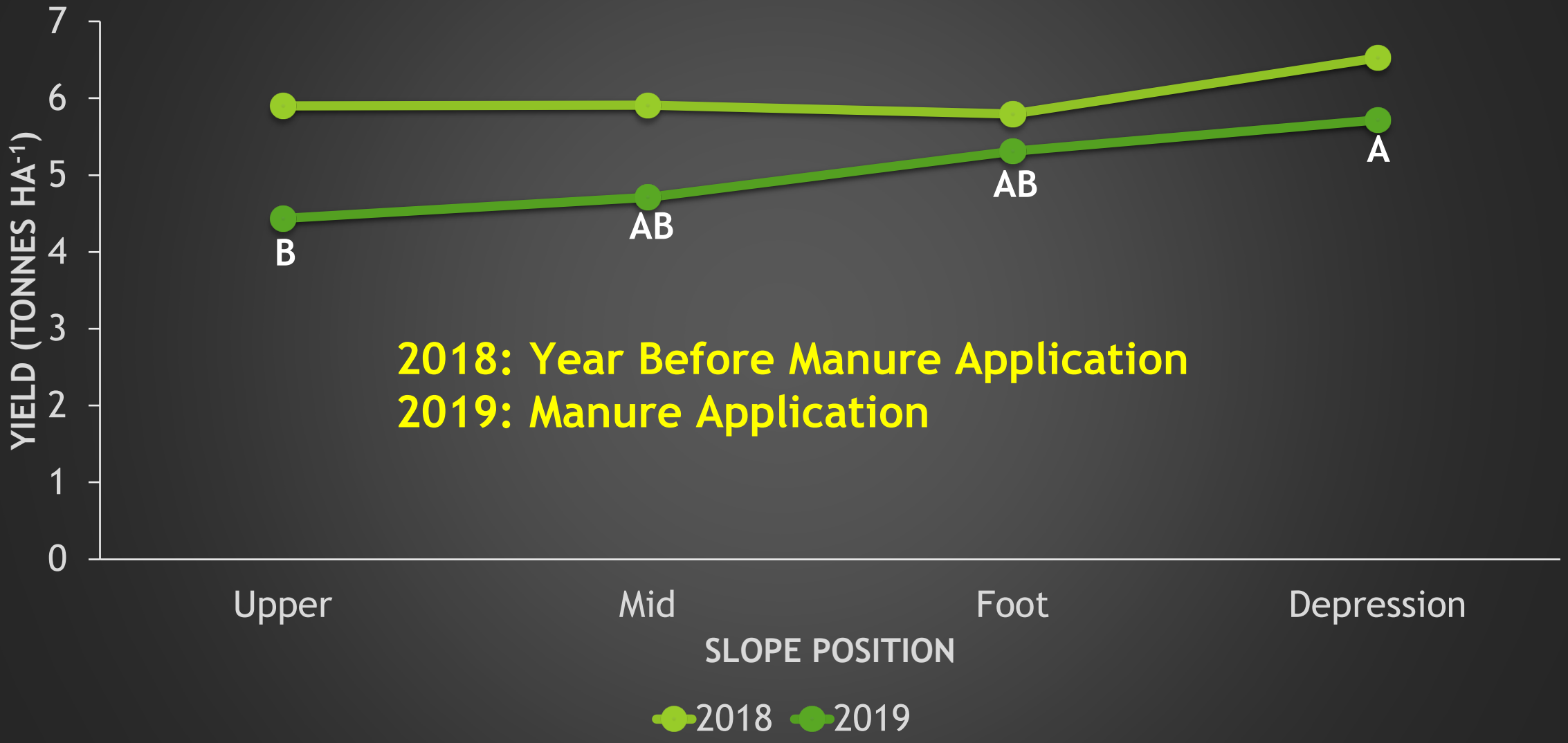
Seeding

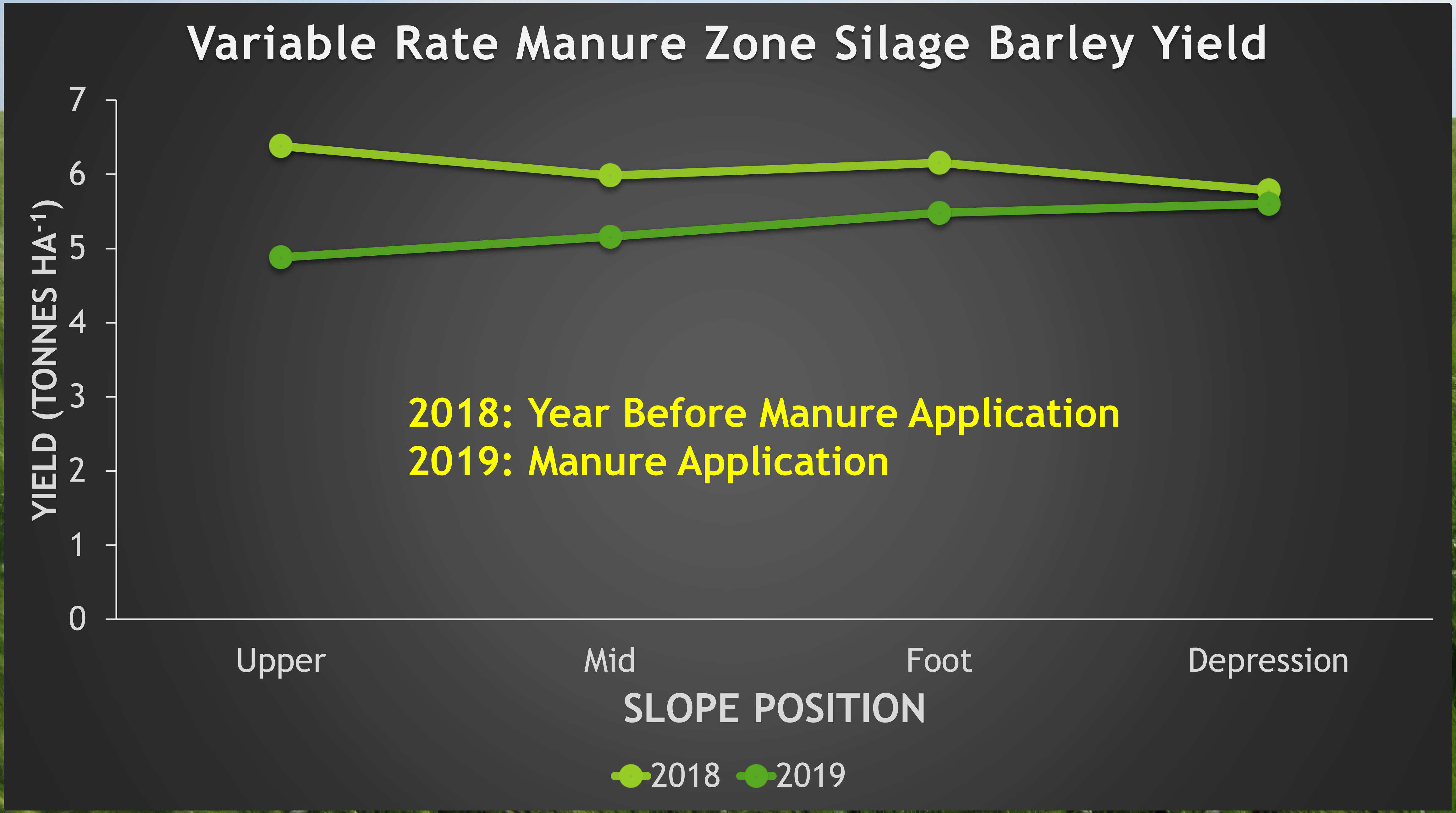
- Site seeded May 30th 2019
- 2 bu ac^{-1} 6-row Ranger barley (*Hordeum vulgare*) with 25 cm row spacing at a depth of 1.5 inches.
- 2019 growing season: drier than normal.

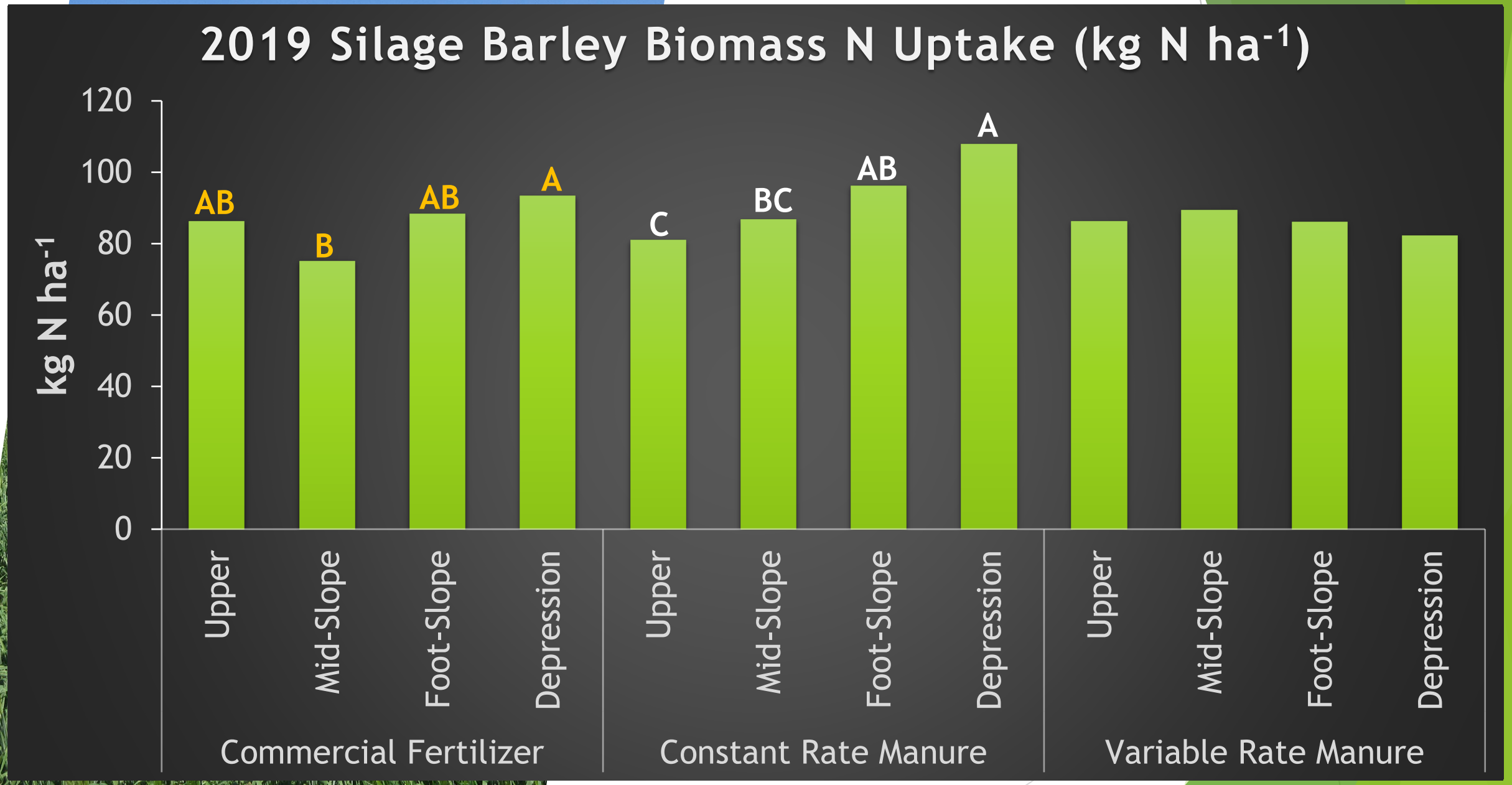
Biomass Yield, N and P Uptake Results

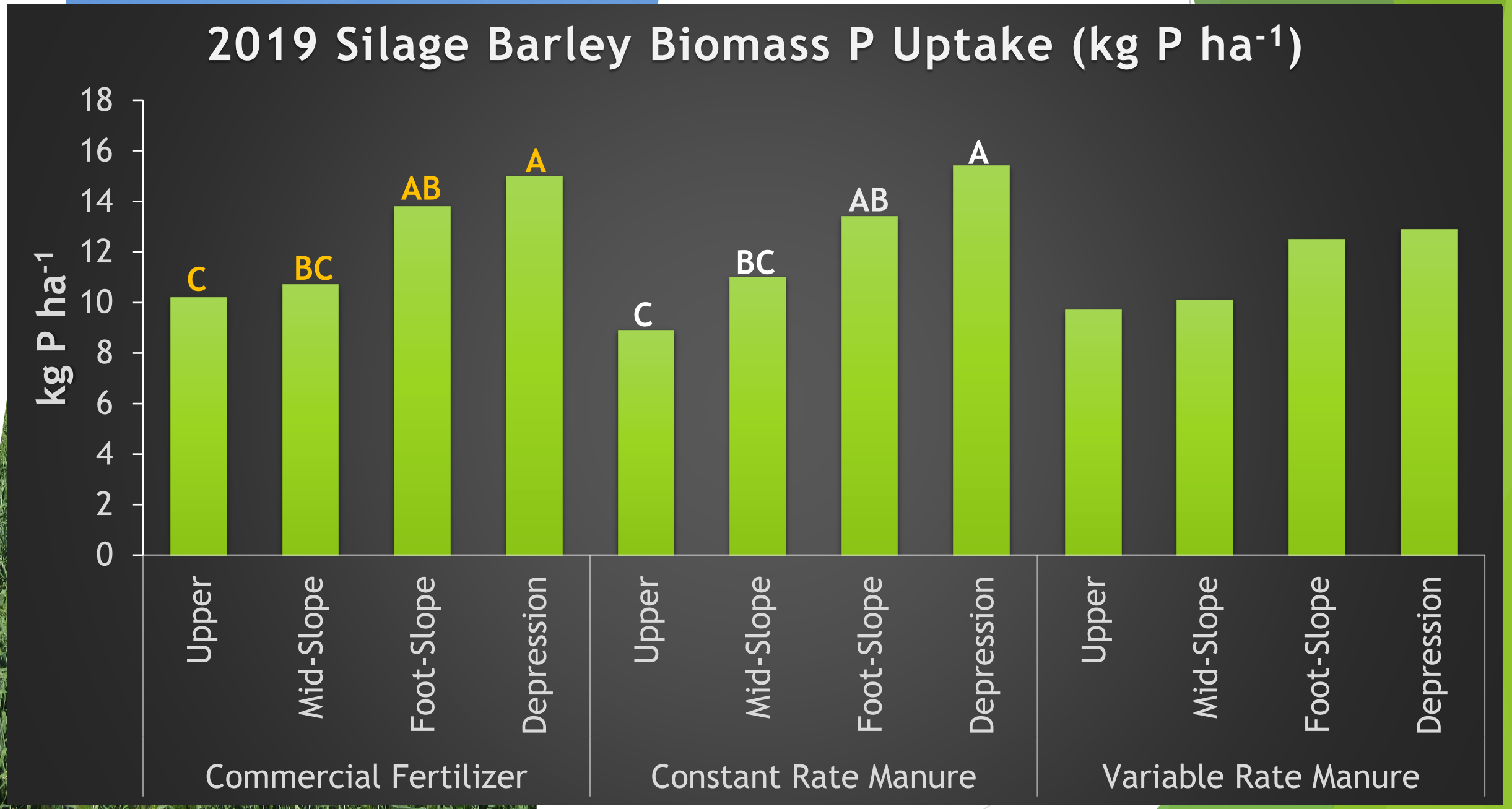

Commercial Fertilizer Zone Silage Barley Yield
YIELD (TONNES HA-1)
8
7
6
5
4
3
2
1
0
A
AB
AB
B
Upper
Mid
Foot
Depression
SLOPE POSITION
2018
2019

Constant Rate Manure Zone Silage Barley Yield

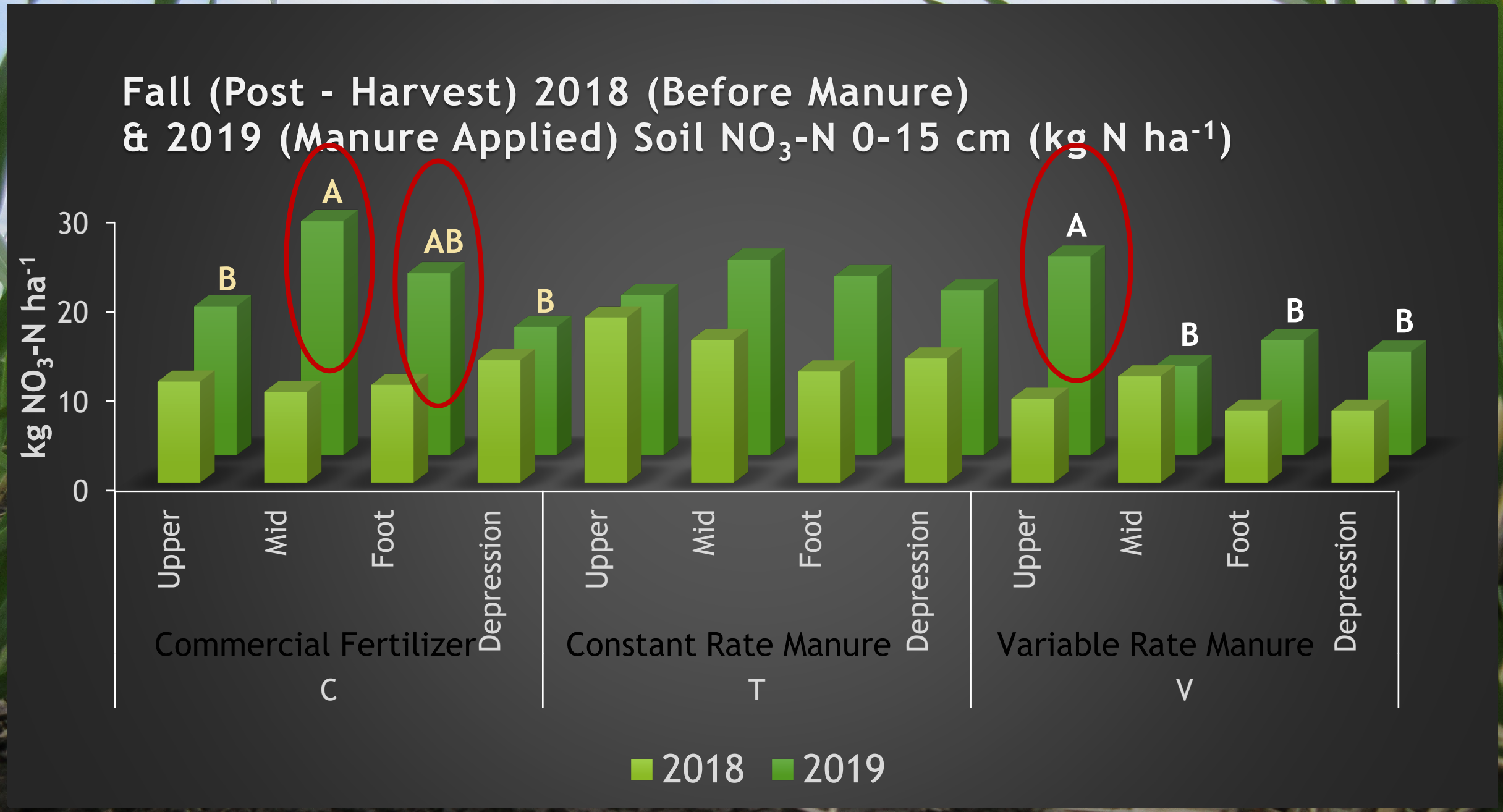


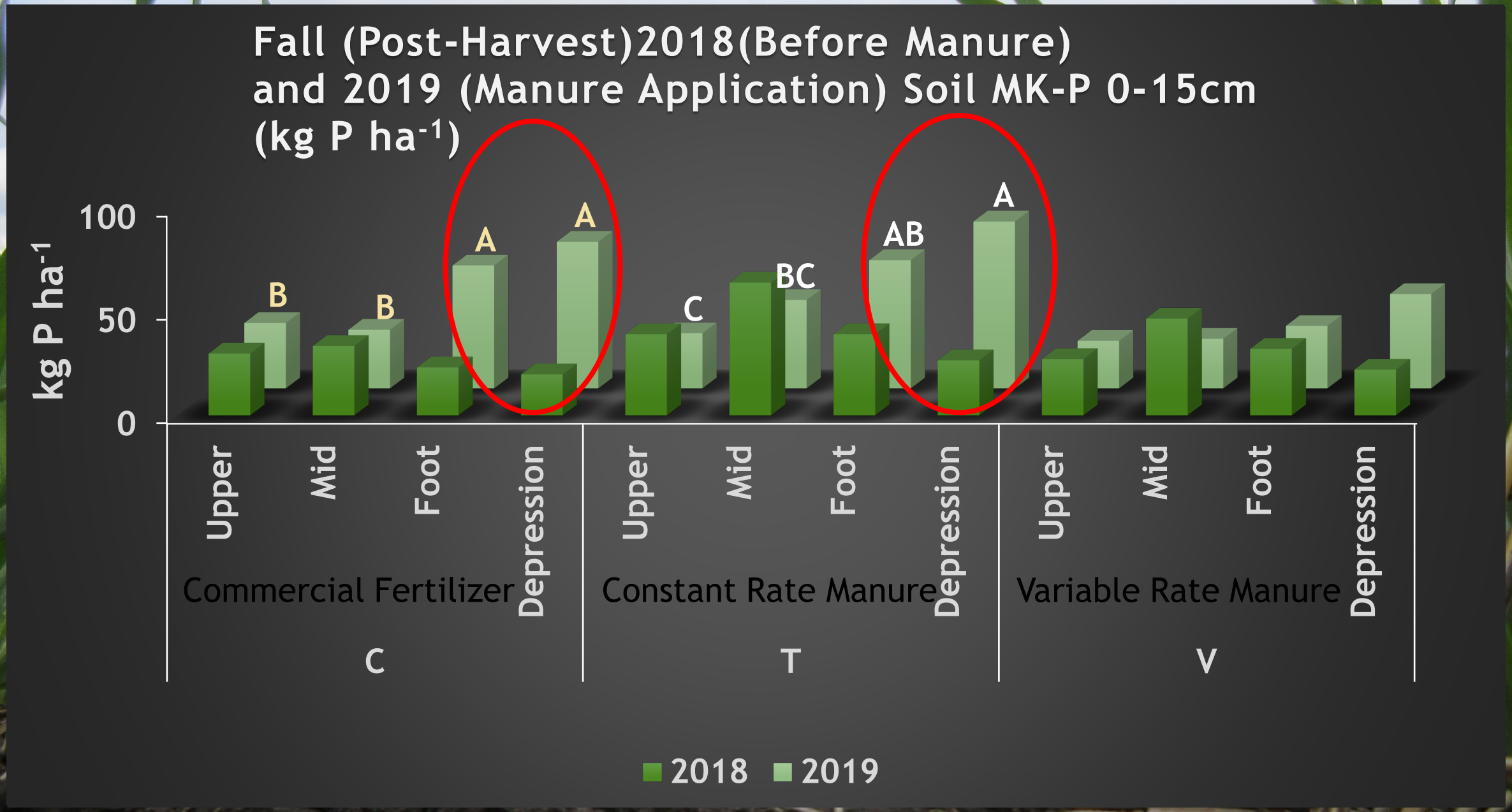

Variable Rate Manure Zone Silage Barley Yield
YIELD (TONNES HA-1)
7
6
5
4
3
2
1
0
2018: Year Before Manure Application
2019: Manure Application
Upper
Mid
Foot
Depression
SLOPE POSITION
2018
2019


2019 Silage Barley Biomass N Uptake (kg N ha-1)
kg N ha-1
120
100
80
60
40
20
0
AB
B
AB
A
C
BC
AB
A
Upper
Mid-Slope
Foot-Slope
Depression
Upper
Mid-Slope
Foot-Slope
Depression
Upper
Mid-Slope
Foot-Slope
Depression
Commercial Fertilizer
Constant Rate Manure
Variable Rate Manure


2019 Silage Barley Biomass P Uptake (kg P ha-1)
kg P ha-1
18
16
14
12
10
8
6
4
2
0
C
BC
AB
A
C
BC
AB
A
Upper
Mid-Slope
Foot-Slope
Depression
Upper
Mid-Slope
Foot-Slope
Depression
Upper
Mid-Slope
Foot-Slope
Depression
Commercial Fertilizer
Constant Rate Manure
Variable Rate Manure

Soil
N & P Results


Fall (Post - Harvest) 2018 (Before Manure)
& 2019 (Manure Applied) Soil NO3-N 0-15 cm (kg N ha-1)
kg NO3-N ha-1
30
20
10
0
B
A
AB
B
A
B
B
B
Upper
Mid
Foot
Depression
Upper
Mid
Foot
Depression
Upper
Mid
Foot
Depression
Commercial Fertilizer
C
Constant Rate Manure
T
Variable Rate Manure
V
2018
2019


Fall (Post-Harvest)2018(Before Manure)
and 2019 (Manure Application) Soil MK-P 0-15cm
(kg P ha-1)
kg P ha-1
100
50
0
B
B
A
A
C
BC
AB
A
Upper
Mid
Foot
Depression
Upper
Mid
Foot
Depression
Upper
Mid
Foot
Depression
Commercial Fertilizer
Constant Rate Manure
Variable Rate Manure
C
T
V
2018
2019

Key findings to date

- Overall, silage barley yields among treatment zones C, T, and V were similar, not significantly different.
- Yields and nutrient uptake were more variable across constant rate landscapes. Variable rate smoothing out yield and uptake.
- Reduction or elimination of manure application in footslopes and depressions did not result in yield reduction. N and P uptake, however, were reduced.
- Variable rate manure application resulted in significantly greater NO_3-N in the top 0-15 cm of the upper slope position.
- In dry years, increasing rate on upper slopes may not be beneficial.
- Accumulation of soil available P at lower slope positions in commercial fertilizer and constant rate manure application zones points to benefit from reduced rates in these landscape positions.

Future Research

- Continue monitoring yields, N and P uptake, soil residual P and N as manure organic matter mineralizes over subsequent growing seasons

- Evaluate accumulation of NO_3 and P in the soil at depth over time

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Questions
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